A Sustainable Micromobility Framework for Freight Deliveries in Urban Environments – Project 3

Deliverables and Reporting Requirements for UTC Grants Awarded in 2023 (June 2023)

Exhibit D

Recipient/Grant (Contract) Number: The University of Tennessee; Oregon State University, Grant No. 69-A3552348338

Center Name: Center for Freight Transportation for Efficient and Resilient Supply Chain (FERSC)

Research Priority: Improving Mobility of People and Goods

Principal Investigator(s): David Porter (OSU), Salvador Hernandez (OSU), Philip Carleton (OSU)

Project Partners: E-cargo bike manufacturers and companies such as B-Line and Stuart

Research Project Funding: $40,000 Federal and $20,000 non-Federal funding

Project Start and End Date: 10/01/2024 – 09/30/2025

Project Description: The U.S. continues its reliance on petroleum to propel vehicles, heat buildings, and produce electricity. In 2022, the transportation sector accounted for 66.6% of total U.S. petroleum consumption (US EIA, 2023). More specifically, freight truck fuel consumption increased by 16.5% from 2011 to 2021 while truck vehicle-miles-traveled increased by 22.4% (U.S. DOT, 2019). These trends are concerning to transportation planners and policymakers across the country because cities are facing the ever-growing challenge of urban freight transportation demand and its harmful associated externalities (i.e., congestion, traffic conflicts, and pollutants). An approach that has gained significant attention as a potential solution to oil dependency in freight transportation and corollary emissions is micromobility. Micromobility is broadly defined as “any small, low-speed, human- or electric-powered transportation device, including bicycles, scooters, electric-assist bicycles, electric scooters (e-scooters), and other small, lightweight, wheeled conveyances.” (Shaheen et al., 2015; FHWA, 2021). In recent years, micromobility transportation options such as cargo cycles (including manually- and electrically-powered bicycles and tricycles) have been considered by many cities as a potential alternative for making last-leg deliveries (Ding et al., 2024; Narayanan & Antoniou, 2022; Rudolph & Gruber, 2017; Tipagornwong & Figliozzi, 2014) because of their advantages over fuel-powered vehicles. These advantages include their ability to use both roadways and cycle lanes, their potential to reduce shipping fees (since they save in parking, congestion charges, and fuel costs), and the fact that they produce zero emissions (Iwan et al., 2015; Dampier & Marinov, 2015; Koning and Conway, 2016).

Freight delivery makes up a large portion of urban daily traffic and is indispensable to economic vitality in cities (Shojaei, 2020). Given the foreseeable rise of on-demand freight in the post-pandemic era, this research proposes the development of a sustainable framework for freight deliveries in urban environments based on micromobility transportation options. Due to their characteristics, micromobility transportation options are an ideal solution to address the most challenging aspects of last-mile logistics, including traffic congestion, atmospheric pollution, and accidents. An urban city located in the Pacific Northwest will serve as the base for a case study to assess the feasibility of the framework.

To achieve the aims of this research, the following tasks are anticipated:

- Conduct a comprehensive literature review to identify research gaps in micromobility-based freight delivery systems. (Lead: OSU)
- Identify the most salient factors that can impact the successful implementation of a micromobility-based freight delivery system. (Lead: OSU)
- Develop preliminary frameworks to support a micromobility-based freight delivery system that can be tested via a simulated case study. (Lead: OSU)
- Document findings and chart a research path forward for the subsequent phases and external funds. (Lead: OSU)

US DOT Priorities: The research project aligns with several key priorities and strategic goals of the U.S.

Department of Transportation (USDOT), as outlined in its strategic plan. Here's how the project supports these priorities and engages in advanced and transformative research:

1. Climate and Sustainability: The project contributes to tackling the climate crisis by improving the resilience of the transportation system. By identifying vulnerabilities and developing strategies to mitigate disruptions, it aligns with the goals of infrastructure resilience and climate justice, reducing the environmental impact of transportation.
2. Transformation: The research engages in transformative and purpose-driven innovation. By utilizing advanced telematics technology and data analysis techniques for assessing freight network resiliency, the project aligns with the USDOT's emphasis on matching research and policy to advance breakthroughs. It represents an innovative and transformative approach to addressing critical transportation challenges.

Outputs: The results of this research will be available to other researchers and practitioners via a GitHub repository including code and test data, a journal paper, and conference presentations. In addition, the results of this research will be integrated into class modules for undergraduate and graduate courses in Civil Engineering and Industrial Engineering at Oregon State University, University of Tennessee and North Carolina A&T State University.

Outcomes/Impacts: It is anticipated that the outcomes of this research will set the stage for more serious consideration of micromobility transportation options (as a valuable supplement to freight delivery systems) by elucidating the main factors that prevent large-scale deployments. These and other research findings will be documented in a final report as well as scholarly publications that can be disseminated via transportation-related journals and conferences. The research team also intends to present our research findings at appropriate conferences (e.g., TRB and/or IISE).